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SEAMLESS LACE LINGERIE ARTICLE

The present invention relates to a lace lingerie article allowing the hold, support and even protection of a part of the female body, on the one hand, and to its manufacture, on the other hand. The relevant articles are mainly brassieres, panties, briefs and thongs, the wearing of which is intended to fulfill at least one of the abovementioned functions.

In the field of lingerie, manufacturers must at all times accept a threefold challenge: ensuring that the user has maximum wearing comfort, maintaining an optimum capacity for support and hold and offering an aesthetic appearance satisfying the tastes of consumers, this last criteria moreover not being the least important.

In the past, lingerie articles were generally produced from plane pieces of fabric or lace assembled to form finished products capable of being used, that is to say ready to be worn. The seams of the various pieces made it possible, in particular, to obtain three-dimensional volumes, for example necessary for producing the cups of brassieres. However, said seams form overthicknesses which may irritate the skin and, in general terms, are a disadvantage which manufacturers have sought to avoid.

Thus, techniques of bonding, welding, etc. were developed and applied to this field in order to reduce and even eliminate the presence of seams.

However, these techniques were never extended to articles produced entirely from lace, which, furthermore, present special problems with regard to the more technical support and holding functions to be performed by these articles. In order to fulfill these, said articles must necessarily consist of a material or a mixture of materials ensuring mechanical stability in accordance with the specific stresses which they undergo both at the time of manufacture and during their useful life. This applies particularly to the cups of brassieres, especially large sizes, for example for D-designated depths, which must define a volume the size of which is proportional to that of the stresses to be controlled.

However, the tulle forming the basic meshing of the lace is, by definition, a very light and perforated material comprising a reduced number of fibers. In a particular example of large-size brassieres, a relatively small number of fibers must therefore be capable of absorbing the same stresses as in the conventional products consisting of a "solid" textile material.

Still with the example of the cups of brassieres, the three-dimensional shape of the cups is generally obtained by molding, and said fibers must therefore also be capable of supporting the deformation imparted during the molding operation.

Finally, said mechanical stability must not only be ensured in the sole supporting zone of that part of the female body which it covers, but also allow a distribution

of the forces over virtually the entire article, said distribution, in particular, taking into account the daily stresses exerted on the various parts of the article, so as to be conducive, to maximum comfort and long life as a product.

The production of a lingerie article consisting entirely of lace therefore presents a certain number of special problems, particularly with regard to the choice of materials to be used, which the present has invention solved. One of the major difficulties is that these problems are interdependent, and that the solution proposed by the invention must adhere to a compromise resulting in the most balanced overall solution.

To achieve this, the lace lingerie article of the invention is characterized in that the lace is produced from an elastic material which is simultaneously thermoformable, weldable and capable of the bonding of at least one reinforcing element, said lace being capable of undergoing, without damage to the lace thread, a permanent deformation by thermal forming during a molding operation for the production of lingerie articles in all the conventional sizes, and preserving after deformation, a mechanical stability and an elasticity such that said articles maintain their capacity for supporting and holding that part of the body which they cover.

There are therefore many conditions and criteria to be fulfilled with regard to the material selected as lace thread, and they have required numerous validation tests before articles correctly ensuring their function, whatever

their size, have been obtained. Since the problem of the cups of brassieres, particularly in the large sizes, is obviously most critical, it will constitute the central example to which reference will be made in the entire text of this description.

For D-designated cups, the thermal forming carried out at the time of the molding of the volume of the cup is much more important than for a cup of smaller size. However, it is essential that the inherent qualities of the fibers are nevertheless preserved after the corresponding deformation, since the weight of the breast to be supported by the cup is, on this assumption, much greater than that of the breasts supported by cups having undergone lesser deformation.

Consequently, in the first place, this deformation must not damage the thread, nor must it appreciably impair its mechanical characteristics.

As a result of tests, it became clear that the lace suitable for solving this problem is composed of a mixture of polyamide and of elasthane. More Specifically in the following proportions: 60 to 80% polyamide and 20 to 40% elasthane.

The best result was obtained with an elastic lace composed of 76% polyamide and of 24% elasthane. Also preferably, said polyamide must be of the 6.6 type, according to repetitive tests conducted by the applicant.

As will be seen in more detail later, the use of suitable materials is a condition which is necessary, but not sufficient, for the manufacture of lingerie articles according to the invention. The method of production of the lace and, in particular, its preforming, which gives it some of its capacity for deformation, are likewise predominant.

In most cases, lingerie articles are covered with reinforcing elements of the lining, pad, protection, etc. type. In this case, this reinforcing element or these reinforcing elements must, of course, be connected mechanically to the lace forming the outside of the article and be capable of undergoing the same stresses.

Thus, according to the invention, the adhesive material used for the bonding of the reinforcing element or reinforcing elements is elastic and thermoactivateable at a temperature such that it can subsequently undergo thermal forming, while at the same time preserving the quality of the bond and maintaining, after deformation, a mechanical stability and an elasticity which are compatible with supporting and holding that part of the body which the lingerie article covers.

One of the essential properties which this adhesive must possess is, of course, that of ensuring the connection between the outer layer and the inner layer, that is to say of presenting inopportune unsticking from occurring between the lining and the lace.

Preferably, the adhesive material is a polyurethane adhesive which is meltable at a temperature below the thermal forming temperature and which remains active during the thermal forming. Even more specifically, this adhesive is meltable from 180 °C.

According to the generic definition given above, the third essential part of the lingerie articles according to the invention consists of the inner reinforcing or protective elements which, moreover, likewise have an effect on wearing comfort.

According to the invention, these consist of a material capable of undergoing the deformation brought about by thermal forming, while at the same time maintaining, after deformation, a mechanical stability and an elasticity which are compatible with supporting and holding that part of the body which the lingerie article which they equip covers.

The same basic condition therefore obviously applies to the three superposed layers, if they are present. It is appropriate to recall, since this was posed with regard to the lace, that these conditions must apply both to large-size cups and to those of small size.

Consequently, the pronounced deformations applied to the first-mentioned must in no way impair the mechanical properties of the reinforcement or of the adhesive material, nor those of the outer lace, in terms of daily use.

According to one possibility, the material used for said reinforcing elements is an elastic jersey allowing a substantially identical elongation longitudinally and transversely. The stitches of the jersey can therefore be drawn in the same way in both directions.

This mechanical behavior, which has a isotropic form on two axes perpendicular to one another is justified because it makes it possible to prevent slips during molding. In fact, in general, the lining of the brassiere is not held, during molding, in its upper part. A stitch which would not have sufficient elongation would consequently slip on the lace, instead of accompanying the latter during the action of the mold, and it would come loose.

More specifically, this jersey consists of 85 to 95% polyamide and of 5 to 15% elasthane.

Tests have shown that, in an entirely preferred way, when the jersey consists of 89% polyamide and of 11% elasthane, the best results are obtained.

In light of the thermal stresses necessary for molding and for bonding, it arises, furthermore, that, if the polyamide is of the 6.6 type, the thread is not damaged.

Since the lining is intended for reinforcing the welds of the articles and of the cups of brassieres, it must have characteristics of responsiveness sufficient for accompanying the deformations which affect them during daily use. This responsiveness, which is defined as the

force exerted in order to obtain an elongation of 40%, is approximately 1.1 N $\pm$ 0 - 5 N longitudinally and transversely, that is to say in the two directions mentioned above.

However, the problem of the choice of the materials is not the only one which has to betaken into account: the method of manufacture of the lace is likewise decisive.

Thus, the lingerie article according to the invention is manufactured from a lace strip preformed for the purpose of the article for which it is intended, the edges of said lace strip being reinforced in order to avoid the need for the fitting of elastic or elastics to said article, the latter being produced by cutting out at least one piece from one of the reinforced edges, without reaching the other edge, by the welding of said piece or said pieces and by the bonding of at least one reinforcing element.

Preforming is different, depending on the use of the article as a brassiere, on the one hand, or as panties, briefs or a thong on the other hand. It involves fixing the width and length dimensions of the lace during a passage on an equalizing frame under temperature conditions in the neighborhood of 185 °C. This operation is carried out before dyeing, and it makes it possible for the articles not to be damaged during the subsequent treatments, in particular mechanical, in the course of manufacture (molding) and during the sequence of washing/wearing cycles in the course of the life of the product.

Preforming thus makes it possible to differentiate the lace, that which is intended for brassieres, the method of manufacture of which entails hot molding, being different from that intended for thongs or briefs, the manufacture of which does not require molding.

Thus, the lace intended for brassieres has more potential elongation in the width direction, for the purpose of making it possible to mold the large depths of cups without difficulty. During this molding, although an elongation of material is produced in length and width, the shape of the cups involves a greater drawing in terms of width.

The reinforced edges of the strip have mechanical properties which make it possible for them to replace an elastic, either around the waist with regard to briefs or thongs or around the bust, under the breasts, with regard to brassieres.

Preferably, the welding of the various pieces obtained by cutting out from one of the reinforcing edges is ultrasonic, thus making it possible to reduce the number of seams on the articles made completely from lace.

When the lingerie article according to the invention is a brassiere, it is manufactured from a lace strip preformed in such a way that its responsiveness, the force exerted in order to obtain an elongation of 40%, is 3.7 N $\pm$ 1.2 N in the direction of length in the middle of the strip, 5.7 N $\pm$ 1.7 N in the direction of length at the reinforced edges and 10.5 N $\pm$ 3.2 N in the direction of

width of the strip. In this case, the lace strip has a width of approximately 30 cm.

It should be noted that the responsiveness of the reinforced edges is greater than that of the middle of the strip, thus clearly indicating that their function is to replace an elastic.

In most case, the cups of the brassieres of the invention are reinforced by means of a bonded lining.

According to a characteristic belonging to the invention, the cups may consist, moreover, of two identical pieces of a shape such that the reinforced edges marking the bottom of each cup are arranged in a herringbone pattern after welding of one to the other.

The production of said herringbone patterns from lace panels has the function of improving the use of fitting by making it easier to place the lower part of the brassiere onto the female bust.

Secondly, the invention also relates to a method for the manufacture of a brassiere satisfying the above characteristics; comprising the following steps:

- preforming, for brassieres, of a lace strip of a width of approximately 30 cm;
- cutting out of pieces to be assembled in order to form said brassieres;
- welding of said pieces;

- coating of the reinforcing material with spots of nonthermoactivatable polyurethane adhesive; bonding of a film of thermoactivatable adhesive material to said material;
- cutting out of reinforcing elements;
- connecting of said reinforcing elements to the lace by the thermoactivation of the adhesive material;
- thermal forming of the cups at a tmnperature of between 190 and 200°C.

Alternatively, the lingerie article according to the invention may be panties, briefs or a thong manufactured from a lace strip which is then preformed in a different way, in order to adapt it to adapt it to the stresses relevant to these articles.

It thus may be preformed in such a way that its responsiveness is 3 N $\pm$ 1 N in the direction of length in the middle of the strip, 4N $\pm$ 12N in the direction of length at the reinforced edges and 18.5 N $\pm$ 5.5 N in the direction of width.

In this case, the lace strip has a width of approximately 34 cm, in order to make it possible to produce all the sizes of briefs or thongs. For these articles, the lace has a lower elongation capacity, but a greater responsiveness in the direction of width, than in the version for brassieres.

Since no part is molded, the welded parts are reinforced by means of a bonded lining.

As with regard to brassieres, the invention relates secondarily to a method for the manufacture of lace panties, briefs or a thong satisfying the above characteristics, and comprising the following steps.

- preforming, for panties, briefs or thongs, of a lace strip of a width of approximately 34 cm;
- cutting out of at least one piece forming the panties, briefs or thong;
- welding of said piece or pieces;
- coating of the reinforcing material with spots of nonthermoactivatable polyurethane adhesive;
- bonding of a film of thermoactivatable adhesive material to said material;
- cutting out of reinforcing elements;
- connection of said elements to the lace by the thermoactivation of the adhesive material.

In the methods for manufacture of a brassiere, on the one hand, and of panties, briefs or a thong, on the other hand, the arrangement and layout of the pieces intended for forming these articles are, of course, optimized on their respective lace strips, as may be gathered in more detail from the following detailed description.

To be precise, the invention will now be described in more detail, with reference to the accompanying figures in which:

- figure 1 is a front view of a lace brassiere according to the invention, provided with a reinforcing pad in the region of the cups;
- figure 2 illustrates a lace strip preformed for the production of brassieres, with the layouts of the pieces intended for forming the cups;
- figure 3 shows diagrammatically the assembly of the two cups in a herringbone pattern;
- figure 4 illustrates diagrammatically lace briefs according to the invention;
- figure 5 illustrates a thong; and
- figure 6 illustrates, by way of example, the optimization in the layout of the pieces to be cut out from a lace strip preformed for the production of thongs.

Referring to figure 1, the lace brassiere of the invention comprises two parts symmetrical with respect to an axis (A), in the region of which the ultrasonic welding of said parts takes place, in the zone designated (1).

The brassiere is thus formed without any seam, and all that remains is to add the fastening and adjusting devices, on the one hand, to the two lateral ends (2, 3) for fastening at the back and, on the other hand, in the region of the straps.

These consist of front portions connected to the rear portions (4, 5) provided to be connected to the rear portions (6, 7) by means of a mechanical device allowing size adjustment and are accessible, for example, above the shoulder.

After welding, the brassiere therefore consists of a single piece formed entirely by lace, including the lower part consisting of the reinforced edge (8) which, as mentioned above, replaces an elastic.

The presence of this reinforced edge (8), by avoiding the need for the fitting of an elastic, further optimizes the manufacture of a brassiere, by eliminating the step which this fitting would have made necessary, and affords an advantage in terms of wearing comfort, since it makes it possible to manage without any seam in this tight-fitting zone around the bust.

Finally, in aesthetic terms, the lower edge of the brassiere surrounding the female bust under the breasts becomes lighter, while at the same time preserving the mechanical efficiency of an additional elastic.

A reinforcing pad (9) is arranged in the bottom of the cups, that is to say in the zone which undergoes the greatest mechanical stresses, owing to the weight of the breasts.

This pad (9) is located in the regions undergoing molding (10, 10') in order to produce volumes forming the cups of the brassiere. This molding, carried out by thermal forming, must not damage the connection between the pad (9) and the lace and must not impair the mechanical qualities of the article in terms of support and hold, whatever the size of the cups to be molded,

Consequently, as explained in detail above, the mechanical properties of the three layers, lace, adhesive material and pad (9), must be such that they can withstand, without any appreciable impairment of their mechanical properties, the deformation which occurs as a result of the thermal forming.

Referring to figure 2, the optimized layout of the cups (BI, B2), each starting from a reinforced edge (8), shows, in particular, that an angle greater than 90° is introduced between said reinforced edge (8) and the line (11) at which the fastening to the other cup takes place.

This line (11) is illustrated by dashes, since the portion which it delimits with the outer line is intended to be severed after the welding of the cups, as illustrated in figure 3. The presence of this angle greater than 90° makes it possible for the lower reinforced edge (8) of the front part of the brassiere to be shaped in the form of a herringbone

As may be gathered from figure 2, these reinforced edges are in fact scalloped and therefore have a different responsiveness from that of the other regions of the lace, in order to ensure its function, that is to say the replacement of an elastic.

The scalloped reinforced edge (8) is, of course, located at the upper edge of the briefs illustrated in figure 4, which is produced from two separate lace pieces welded at the hips at the dashed lines (12, 12').

These zones have bonded to them an inner reinforcing element represented at the hips by the hatched zones (13, 13').

The same applies to the thong illustrated in figure 5, which, however, is produced with a single piece welded at the dashed line (14) and which has only a single reinforcing element indicated by the hatched portion (15)

The layout of the single piece intended for forming the thongs is illustrated in figure 6, in the lace strip preformed in order to produce this article.

As with all the other articles, said layout is made from one scalloped reinforced edge (8) in the direction of the other edge, but without reaching the latter.

In all cases, in fact, the elastic function is required on the periphery of the female body at one location only.

The examples of layouts appearing on the lace strips, on the one hand, and the shape of the lingerie articles in the figures, on the other hand, have of course, merely an illustrative value and cannot be considered as exhausting the invention. On the contrary, the latter embraces all the variants of shape and of production which it is possible to implement with the lace strips, the characteristics of which have been specified above.